Morphing wings for airborne wind energy - one step closer to harvesting the sky?

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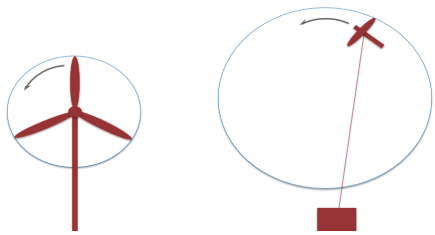
New research shows the potential use of morphing wings for airborne wind energy applications. The morphing technology could potentially lead to a more efficient and compliant system.

Airborne wind energy is a novel technology within renewable energy. Instead of using a turbine that spins on a fixed tower, as with conventional wind energy, airborne wind energy uses a wing connected to the ground via a tether. By letting the wing fly in a circle or in the pattern of an eight the kinetic energy in the wind can be converted into electric power. The complexity of such a system is of course greatly increased, but the reward might be worth the struggle. Airborne wind energy has the potential of reaching higher altitudes than conventional wind power. This would not only mean higher wind speeds (i.e. more power) but also winds that cannot be used for power conversion today. With this in mind it is not totally wrong to consider airborne wind power as a new renewable energy source, which conventional wind power could not reach.



Comparison between conventional- (left) and airborne wind energy (right)

Morphing wings is not a new concept, nor a new technology. For example, the Wright brothers used morphing wings on some of their applications in the beginning of the twentieth century. The prospect of the technology shows many benefits, for example the shape could be changed in order to be optimized for any flight condition and it would get rid of the air pockets between main wing and wing flap which increases drag. The obvious question that comes into mind is: *if it is so good, why are not morphing wings used more today?* The answer is that a lot of the applications for flight today demands high loads on the wing structure which generally leads to the use of non-compliant materials. However, with new breakthroughs in material sciences in the last decades morphing wings has become more interesting again.

The research project has previously completed an optimization of the shape of the morphing wing. However, the new results have been found by using fluid structure interaction simulations with higher accuracy than the optimization. The results shows that the morphing concept of the airborne wind energy wing has the potential to accustom its shape to extreme wind conditions, such as gust winds, in order to alleviate extreme loads. The morphing concept could potentially be applied if the wind speed would decrease as well. In this case there would be a risk of loosing altitude, but the wing could change its configuration to one that gives more lift force. With this in mind the wing could fly at a larger range of wind conditions which would lead to a more stable power generation. At the same time the overall mass of the wing could be decreased by alleviating loads instead of making a wing more robust and heavier in order to withstand the high loads.

One must of course remember that the novel technology has many challenges ahead of it. However, I for one find it difficult not get excited at the thought of flying wind power with wings adapting their shapes to different wind conditions.